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# ML Directorate develops waste stream treatment

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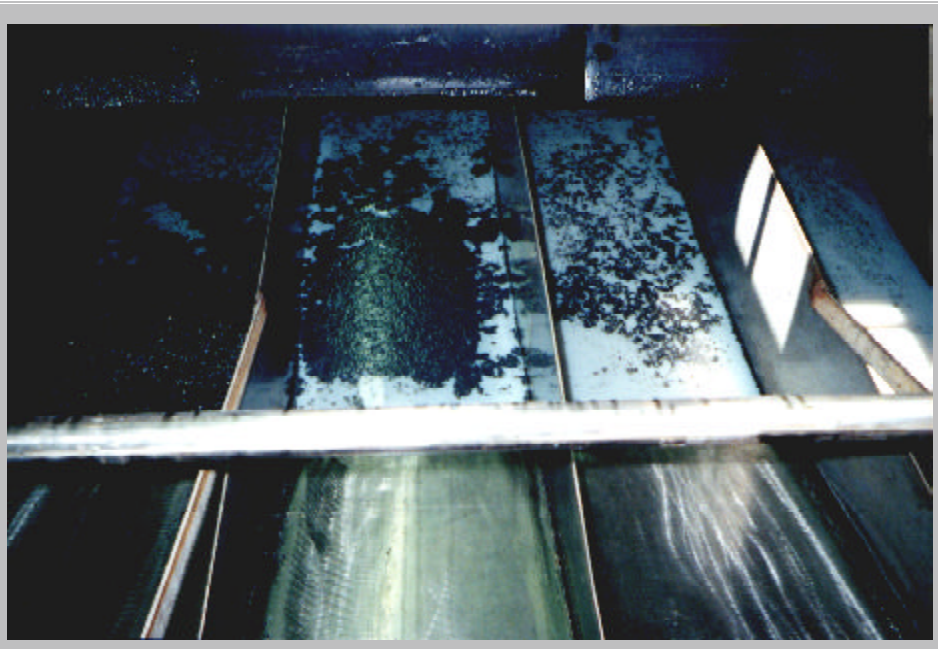
*WRIGHT-PATTERSON AIR FORCE BASE, Ohio* — Researchers at the Air Force Research Laboratory's Materials and Manufacturing Directorate are developing cost-effective technologies to treat waste streams that contain emulsified petroleum-based substances such as fuels, oils and greases. The time-saving technologies can also be used to treat fire fighting chemicals, such as Aqueous Film Forming Foam (AFFF) that is used to suppress combustible and flammable liquid fuel fires.



*Removal of oil and grease from emulsified waste stream in ASH clarifiers*

Many Department of Defense (DoD) activities create waste streams from operations such as motor pool and aircraft wash racks, fuel tank cleaning operations, storm drains, and fire fighter training. To ensure optimal waste stream management, researchers have evaluated several different treatments, including biological treatment, reverse osmosis, and other physical and chemical removal methods. The most effective treatment system they have found is Air-Sparged Hydrocyclone (ASH) Technology, which was developed through collaborative research between AFRL, the Naval Facilities Engineering Service Center and the contractor, Kemco Systems, Inc.

Air Force researchers expect this technology will be a valuable tool in treating a variety of DoD generated waste streams where prior alternative treatment methods were non-existent, ineffective or extremely costly. Until now, solutions to wastewater challenges included "pump and treat," where a contractor takes the waste stream away at a significant cost to the military. Another solution was sending a small amount (due to the high toxicity and foaming characteristics of AFFF) to the industrial wastewater treatment plant each day. However, installations using this method generate more than they can send out each day, making this a larger problem as time passes.

Anxious to test the ASH technology, researchers developed a field test/demonstration project to validate the effectiveness of the ASH system at removing emulsified fuels, oil and grease, and AFFF from waste streams generated at nine DoD sites. The objective of the project was to demonstrate the commercial viability of the system, to allow an audience to witness the operation of the technology, and to open doors for transfer of the technology to other DoD agencies and industry.

The ASH system works by combining flotation principles with the separation characteristics of a hydrocyclone, which separates fuel, oil and grease from water. In the case of fine particles and oil removal, the ASH system improves the ability of fine particles and oil droplets to float. First, a strong centrifugal force field is developed, which increases the inertia of fine hydrophobic particles and oil droplets. Second, a high-speed swirl flow exerts considerable shear force at a porous wall. When air is introduced through the extremely fine pores in this wall, numerous small air bubbles attach to the particles and oil droplets. When the bubble and particle or droplet are attached, they are transported a short distance and are removed from the water.

When used in the removal of AFFF or any other foam-generating compound, the ASH system uses the compound's own foam-forming capabilities to strip it from water. These com-

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pounds are comprised of surface-active substances that concentrate where air and water interface to generate stable foams. The ASH's uniquely controlled aeration and flow control process effectively separates the AFFF compound from water.

During the demonstration, success of the system was determined by comparing the post-treatment concentrations of fuel, oil, and grease, total suspended solids, and AFFF to influent concentrations and local discharge limits. In the absence of a regulatory limit of AFFF, a target value of under 50 parts per million (ppm) was used.

The ASH system consistently met its objectives of demonstrating and quantifying its ability to effectively and efficiently remove emulsified oil and grease, and AFFF from wastestreams. The system resulted in an average removal rate greater than 87 percent and greater than 90 percent for oil and grease removal and AFFF removal, respectively. These results were achieved in streams that contained varying types and concentrations of contaminants, in streams that contained oil and grease only, AFFF only, and in streams that contained a combination of all contaminants.

These results were also achieved in cases of high AFFF concentration (over 500 ppm). A recirculation option was incorporated into the system allowing batch operation. In this fashion, wastewater can be processed multiple times until the desired effluent concentration is obtained.

In most cases, the concentrated sludge remaining from ASH processing was less than 10 percent of the original stream volume, and in many cases, lower than seven percent. Toxicity leaching tests conducted on this sludge reported that the sludge is classified as non-hazardous.

The predicted operating costs for the system are dependent on the specific contamination characteristics of the waste stream. The costs of operation during the DoD demonstrations ranged from $.17 per 1,000 gallons treated for AFFF treatment with no chemical treatment, to $2.54 per 1,000 gallons treated for extremely high oil and grease concentrations with chemical pre-treatment. The operating costs include the cost of consumables and utilities associated with the system. **@**